Code of Practice

PCA Property Care ASSOCIATION

Code of Practice for Waterproofing of Existing Below Ground Structures

August 2017

CODE OF PRACTICE FOR WATERPROOFING OF EXISTING BELOW GROUND STRUCTURES

1. INTRODUCTION

Waterproofing of existing structures has its own unique considerations and waterproofing options will be dependent on many factors including the end use and the condition of the existing structure. Unlike in new build scenarios where a waterproofing designer should be engaged at the earliest design stages, many existing structures have been built with little regard for future waterproofing. Furthermore, the designer also needs to consider what is possible within the confines of the structure. This limits the waterproofing options and normally results in the reliance on a single waterproofing system. This code of practice details the considerations that should be adhered to, in order to minimise the risk of failure when waterproofing existing structures.

This Code of Practice is issued by the Property Care Association hereinafter referred to as 'the Association'. This Code of Practice is aimed at providing guidance for contractors, surveyors and other specialists involved in the planning and provision of usable spaces in existing structures that are below ground and is based on current best practice.

Information is also given on associated matters and, where appropriate, references made to other documents, legislation etc.

2. DEFINITIONS

For the purpose of this document, the following definitions refer:

TYPE A – BARRIER

Structure constructed from concrete or masonry, offering only limited protection against the ingress of water by the nature of its design. Protection is therefore primarily dependent on a barrier system applied to the structure, combined with serviceable land drainage where appropriate.

TYPE C - DRAINED PROTECTION

Constructed from structural concrete (including diaphragm walls) or masonry to minimise the ingress of water. Any water that does find its way into the below ground structure is channelled, collected and discharged within the cavity created through the addition of an inner skin to both walls and floor.

CAVITY DRAINAGE MEMBRANE (CDM)

Dimpled, flexible, high-density polymer sheet, which can be placed against the internal face of a structure after construction and is designed to intercept water penetrating the structure and direct it to a drainage system. CDM may need to be installed during construction where an internal wall is built - for example.

DRY PACK

A low-shrinkage filler material that transmits the load of the building to the underpinning.

HYDROSTATIC PRESSURE

Water pressure exerted as a result of hydrostatic head pressure created by water.

INTERSTITIAL CONDENSATION

Condensation which occurs within an element of the building fabric.

PLASTER

The term 'plaster' refers to any applied coat whose cementing action comes from either gypsum or cement / lime.

RENDER

The term 'render' refers to any applied coat which is made up of a sand: cement mix only, and can be used for coatings applied internally or externally. It may incorporate water-resisting admixtures, accelerators, plasticisers, or other approved additives.

STRESS

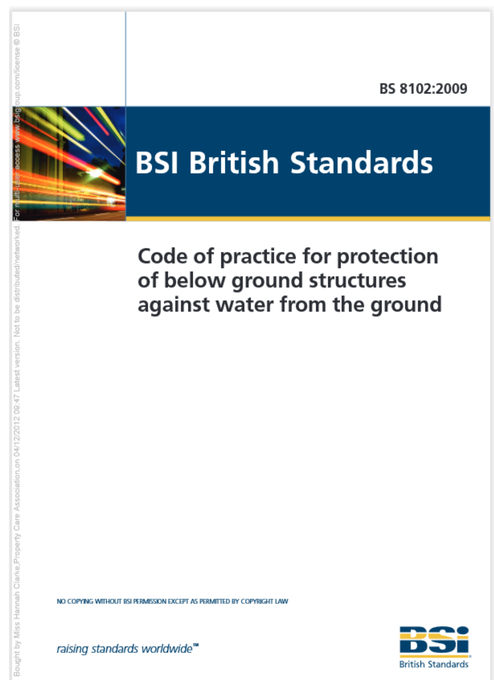
Stress is the pressure that builds up within the elements of a structure to resist applied loads and / or pressures.

TANKING
The term 'tanking' refers to a pressure resisting waterproofing system that is applied internally or externally to a structure, which will prevent any lateral penetration of liquid, either by capillary action or by hydrostatic pressure.
VAPOUR CHECK
Any layer which reduces the passage of water vapour, resulting in a build-up of humidity immediately behind it, is known as a vapour check.
VAPOUR CONTROL LAYER
A vapour control layer is a strategically placed vapour check, used where control of water vapour is needed.
VAPOUR RESISTANCE
The ability to resist water vapour.
WATERPROOF
A material or layer that is impervious to the passage of water.
WATERPROOFING
The application of a material that is impervious to water.
WATER VAPOUR
Water in its gaseous phase.

3. PRINCIPLES OF DESIGN

BS 8102:2009
The Code of Practice for protection of below ground structures against water from the ground provides guidance on the methods which can be adopted to deal with and prevent the entry of water from the ground into a structure that is below ground level. It is widely referred to and used in basement waterproofing, making particular reference to:

- Water table classification
- Defects and remedial measures



All elements (including foundations, walls and floors) forming a below ground structure requiring waterproofing should be suitable for their intended purpose.

Habitable accommodation should be designed to "Grade 3" as described in BS 8102: 2009 that *'no water penetration is acceptable and a dry environment will be provided if maintained by adequate ventilation'*.

Plant rooms and storage should achieve "Grade 2" as described in BS 8102: 2009 as no water penetration is acceptable although damp is tolerated. However, consideration should be given to the type of plant and stored items and their sensitivity to damp and any particular environmental controls required.

Storage or plant rooms where the internal finishes are not readily damaged by moisture should be designed to a minimum "Grade 2" as described in BS 8102:2009, as no water penetration is acceptable, although damp is tolerated.

BS 8102: 2009 Table 2;

Grade	Example of use of structure A)	Performance level
1	Car parking; plant rooms (excluding electrical equipment); workshops	Some seepage and damp areas tolerable, dependent on the intended use B) Local drainage might be necessary to deal with seepage
2	Plant rooms and workshops requiring a drier environment (than Grade 1); storage areas	No water penetration acceptable Damp areas tolerable; ventilation might be required
3	Ventilated residential and commercial areas, including offices, restaurants etc.; leisure centres	No water penetration acceptable Ventilation, dehumidification or air conditioning necessary, appropriate to the intended use

Retaining walls used to form elements such as light wells ideally could be designed to provide “Grade 1” protection, however the client should be made fully aware of the limit to this level and whether this is acceptable to the scheme.

If the client requests a reduced specification (for example, a partial system or cavity drainage membrane system without adequate drainage) the implications of this must be fully explained and understood by the client. The limitations of a partial or incomplete system should be clearly stated in the report and where a quotation is provided for such works it is advisable to also include an alternative quotation for a specification that complies with BS 8102:2009, thus giving the client the ultimate choice.

Designer

Much of the failure associated with structural waterproofing is attributable to insufficient consideration of the relevant factors, leading to poor or inappropriate design. It is therefore essential that where specifying waterproofing, specialists are consulted.

The Property Care Association (PCA) provides training for surveyors and designers of belowground waterproofing systems. The Certificated Surveyor in Structural Waterproofing (CSSW) is a recognized industry qualification which requires an understanding of waterproof systems and the ability to comment on them. The PCA has created a register of Waterproofing Design Specialists (WDS) who have shown further ability to provide design advice for structural waterproofing.

The list of Waterproofing Design Specialists can be accessed through:
www.property-care.org/ProGuidance.RWDS.asp

Installer

Conditions of certification for waterproofing systems will usually require that they are installed ‘under license’ or by those trained by the supplier/manufacturer. ALL installations SHOULD be undertaken by suitably trained, competent operatives. This could be by experienced operatives holding a relevant qualification in the application of structural waterproofing, such as a relevant vocational qualification. Alternatively, operatives trained and licensed by the supplier/manufacturer or the PCA could also provide a suitable demonstration of skill and knowledge.

The designer and installation company should be able to demonstrate experience in the implementation of similar waterproofing projects taking into account scale and complexity.

Site Investigation
An initial site investigation is important to assess the existing structure as its results will have a bearing not only on the waterproofing options considered, but also how the structure may need alteration. Although the findings of a site investigation can be seen as conclusive, consideration should be given that it is often a 'snap shot in time' and conditions on or around the site may change in the future.

It should be assumed that water will come to bear against the full height of the below ground structure at some stage in its life. Designing a system to offer full protection to full height, regardless of any water table classification, should ALWAYS be considered.

Ground gases
BS 8102:2009 advises the designer to take account of the presence of, or potential for, ground gases when considering waterproofing. This is mentioned so that designers can take note of the perceived risks from ground gases and advise their clients accordingly. It should also be noted that high levels of ground gases can accumulate even where basements are protected by a waterproofing membrane (ground gas resistance), and this may lead to the installation of a ground gas management system where the risk assessment, particularly in existing structures, indicates that legislation might otherwise apply.

The likelihood of gases can be established from the underlying geological structure, and guidance for their control may be found in several documents and via official sources on the internet. BS 8102:2009 refers to maps of areas where basic or full protection against radon needs to be provided, which are contained in the Building Research Establishment (BRE) reports BR211, BR376, BR413 and the Health Protection Agency (HPA) documents:

- HPA-RPD-033, Indicative Atlas of Radon in England and Wales, 2007. ISBN 978-0-85951-608-2, available from HPA.
- HPA-RPD-051, Radon in Dwellings in Scotland: 2008 Review and Atlas. ISBN 978-0-85951-634-1, available from HPA.
- NRPB Documents, Vol 4, No.6, 1993, Radon affected areas: Scotland and Northern Ireland. ISBN 085951367X, available from HPA.

Attention is also drawn to the Building Regulations and to further guidance on the characterisation and remediation of ground gases given in BS 8485. In view of health issues concerning radon, due vigilance should be observed regarding any revisions to these documents and other official sources.

Methane and other gases are likely to be linked to infill and made-up ground, particularly where large amounts of organic matter have been buried. Such sites can also present risks from acid wastes, mineral oil shales, and other fill materials. Some slags and other residues often contain toxic materials and some furnace ashes may be reactive. The Building Regulations give information on site preparation and resistance to moisture, and include guidance on ground contaminants.

Note: The control of ground gases requires specialist advice prior to specifying any form of barrier.

4. THE OBJECTIVES AND PRACTICE OF STRUCTURAL WATERPROOFING OF EXISITING STRUCTURES.

The objective of structural underground waterproofing is to achieve effective control of water caused by penetration and to reduce the likelihood of further deterioration of the building fabric or finishes in below ground spaces.

The designer of the belowground waterproofing system must first consider the client's requirements. They must then provide a design solution that can be installed successfully and will deliver the performance characteristics specified by the client. To achieve this, the designer must consider the structure as well as the prevailing soil and ground conditions as detailed in the previous section.

The PCA provides training for surveyors and designers of underground waterproofing systems. The recognized industry qualification is the Certificated Surveyor in Structural Waterproofing (CSSW). Information about training courses and qualifications are available from the Property Care Association.

It is important that during all stages of the design process the designer, specialists and the operators installing the waterproofing systems establish robust channels of communication. Regular and clear communication coupled with good site supervision will allow variations and amendments to the design to be planned and executed without compromising the waterproofing system.

The designer of the waterproofing system should also consider the implications of any future failure of the system and how any defects can be repaired in the future.

NOTE: When considering the design of a waterproofing system, it is essential that consideration be given to the form and feasibility of remedial work should the system fail for any reason.

Contrary to new-build scenarios, there are limitations inherent when working within the confines of an existing structure, in that there is typically a limited opportunity or scope to make structural alterations for the purpose of installing a given system.

The designer MUST provide initial or first-stage measures of protection against groundwater. It is often the case that designs are provided for the purpose of remedying failures to address problems with systems of considerable age in older or historic property, or to facilitate change of use.

Options may be limited by the confines of the structure, for example tanking should not be applied to substrates which are not capable of absorbing potential loads applied by Hydrostatic Pressure. It is important to understand what that structure is, and equally, the nature of any installed waterproofing measures within it, which may further influence design.

Therefore, an analysis, through visual inspection, inspection of drawings (where available), and potentially intrusive investigation, i.e. trial hole formation, should be undertaken so that a thorough understanding of the structure and how it is constructed, is developed. The effects of any structural discontinuity, as may typically occur in an existing structure, must also be assessed.

Once the structure is understood and objectives and instructions are defined, it is the role of the Waterproofing Design Specialist to configure products and systems within that structure, all the while considering the appropriate factors detailed within this Code of Practice, so that the objectives are successfully met and structures are protected in the long term.

5. SURVEYING

When surveying an existing structure for a waterproofing system, the following procedures should be regarded as a minimum:

- Establish the intended use of the area and type of finish required.

- Establish the type and condition of the existing structure.
- Assess the ground conditions relating to water table, permeability and aggressive contaminants.
- Select the appropriate generic system.
- Prepare a detailed specification.

Type and Condition of the Structure

The surveyor should determine the type, condition & finishes of existing walls, floors and ceilings and note any flat soffits. The survey may need to be invasive, possibly including trial holes, to establish this detail, particularly in the case of solid floors. Consideration must be given as to whether the existing structure will require any upgrading prior to installation of the waterproofing system. The services of a structural engineer may be required at this stage.

Any item, fixture or feature that could impede a continuous or full system must be identified and considered (e.g. door/window frames, staircases, floor timbers, partition walls, services etc).

All timbers which could be affected by moisture and therefore vulnerable to fungal decay should be noted. These should be replaced with an alternative material or isolated.

Any previous waterproofing 'treatments' should be noted.

Type B structures may also be encountered where leaks through cracks, construction joints and defective concrete may manifest themselves. (Specialist concrete repairs are generally outside the scope of this COP although installation of a Type C system may be considered as a solution).

Ground Conditions

The surveyor should consider external factors such as, rainwater goods, adjacent water courses, wet ground, local topography, adjacent buildings, roads, pavements, coal chutes etc.

Attention should be paid to any existing external drainage. The surveyor should note the effects of the external drainage on the proposed waterproofing system.

It will sometimes be prudent to recommend that the client commissions a complete soil survey so that this can be considered by the designer of the waterproofing system.

In all cases, water table levels stated in BS8102 should be assumed and the system designed accordingly unless specifically requested otherwise by the client, as previously stated.

Ventilation

Condensation is dampness generated from within a structure and will not be eliminated by the application of a structural waterproofing system.

It is important to consider the likelihood and implications of condensation when the waterproof system is being designed. Waterproofing systems that conform to grade 3 (BS8102) MUST always include reference to heating and/or ventilation.

6. CONTENTS OF A WATERPROOFING REPORT AND SPECIFICATION

In order that the specialist surveyor can properly discharge their obligations to their client we recommend that any submission supplied, should contain the following minimum levels of information.

The report should, when appropriate, include reference to the following:

- Confirmation of clients' instructions
- Limitations/restrictions of survey
- Clients required use of the basement and therefore the design grade required (i.e. 1, 2 or 3 as defined in BS 8102:2009)
- A description of existing basement construction
- If known, the soil/ground type and permeability
- Defects/moisture sources that require rectification in conjunction with waterproofing works
- Proposed generic waterproofing method(s) e.g. Cementitious Multi coat render, Cementitious Slurry, CDM etc
- Suitability of existing structure to accept proposed system and any upgrading works required e.g. a new floor slab etc.
- How existing staircases will be isolated from the walls and floor, or incorporated into the waterproofing system
- Reference to condensation control/ ventilation/ dehumidification.
- Reference to a long term guarantee if applicable
- Detailed specification for the chosen method

NOTE: For Type A internally applied systems the floor slab should be designed by a structural engineer

In all situations where waterproofing treatments are recommended the specialist should include the following advice:

- The extent of the waterproofing must be clearly described/ indicated. If a full waterproofing system is not being specified then the reasons for this should be stated and the risks arising from a partial system explained. It should be made clear that the limitations of a partial system are at the client's own risk. Where a partial system is being offered, it is advisable to offer a full system as an alternative so it is the client who makes the choice.
- Preparation works including removal of existing finishes, joinery items, services etc.
- Advice on fixing to/through the system to avoid puncturing the system in the future
- Drawings showing areas to be waterproofed and other relevant details

Where a Cavity Drainage Membrane system is specified, advice should include the following information:

- Position and type of internal drainage including facility for cleaning/inspecting
- Position, size, number and type of pumps – the designed extraction capability of the pumps should be stated
- Pump outlet arrangements
- Pump wiring arrangements
- Membrane type & stud size for walls/floors/ceilings as applicable
- Joint sealing detail if applicable
- Finishes and fixing points
- Pump/drainage servicing requirements and/or agreement.

Where a Cementitious Multi Coat render system is recommended, the report should include reference to:

- Preparation method for masonry and other surfaces as appropriate
- Specific provisions for fixings where required to avoid risks of puncturing the system in the future
- Product type and application method/process
- Floor/wall joint details
- Curing requirements

7. PRODUCTS

When designing a waterproofing system for existing structures the range of products will be more restricted compared to new builds. On the whole, this relates to some Type A and Type C methods of waterproofing (as defined in BS8102).

In existing structures waterproofing is normally restricted to the negative side and this limits product selection further. There are three main types which are in common use:

Multi-Coat Renders

Multi-coat cementitious renders and screeds, modified with chemical additives. The modified mortar is applied by conventional rendering or screeding techniques in several layers. The number of render layers and final thickness are dependent on the conditions likely to be experienced and are specified by the relevant material manufacturer. They are used for waterproofing basements or water retaining structures by internal tanking.

Cementitious Coatings

Pre-mixed cementitious compounds comprising cement, graded aggregates and chemical additives. They are supplied in powder form to be mixed with water and/or polymers on site and applied as a slurry by brush, trowel or spray, to form a coating that is usually between 2mm and 6mm thick. They can be applied direct to sound substrates or they can be applied to a render coat previously applied to the substrate. They can be further modified to improve adhesion, elasticity and flexibility.

Cavity Drainage Membranes (CDM)

These are vacuum formed high density polyethylene or polypropylene sheet materials with moulded studs for application internally to below ground structures, on internal walls, sloped ceilings and floors. They are supplied in roll form and are secured to walls using proprietary fixings. The fixed wall and ceiling membranes are used to support dry lining or may be plastered (depending on the type of membrane), whilst the floor membranes may be screeded or overlaid with wooden flooring.

Cavity drainage systems will not usually put the substrate into tension, but they will need to be adequately drained in accordance with the manufacturers' instructions to either natural drainage or pumping points. Cavity drainage systems cannot withstand any hydrostatic pressure. Mechanical equipment such as pumps will require routine maintenance and the system will fail if there is a breakdown of the power supply and water comes to bear against the drainage membrane. All drainage channels that form part of the system should also be subject to regular routine maintenance in order to ensure the free flow of water to drainage points. It should be determined that the drainage outlet has the capacity to the additional flow.

System Selection

In most circumstances, any one of the above systems can be applied equally effectively. However, the following points should be considered before finally selecting a system.

Cementitious systems require little or no on-going maintenance, can hold back a significant head of water and are not dependent on mechanical parts and an electricity supply. However, when water pressure comes to bear, the substrate will come into tension and bending. The substrate must be strong enough to accept this stress. Non-structural floors and half brick walls are not suited to the application of a cementitious system due to their inability to withstand bending stress. **If there is any doubt about the ability of a structure to absorb the changing stresses caused by waterproofing, the guidance of a structural engineer should be sought.**

Cementitious systems may not be suitable where they are likely to be subject to heavy vibration or substantial seasonal movement i.e. below roads, railway lines etc.

Cementitious systems are versatile in that they can be applied relatively easily to convoluted shapes and to flat soffits. Their success however depends on the bond achieved between the material and the substrate. To achieve a good bond considerable surface preparation may be needed. In this case Health & Safety considerations in relation to noise, hand arm vibration and dust nuisance should be taken into account.

Cavity drainage systems will not usually put the substrate into tension, but they will need to be adequately drained by using drainage channels that are connected to either natural drainage or pumping points. Cavity drainage systems cannot withstand any hydrostatic pressure. Mechanical equipment such as pumps will require routine maintenance and the system will fail if there is a breakdown of the power supply and water comes to bear against the drainage membrane. Battery back-up systems should be included to protect in the event of power failure. All drainage channels that form part of the system should also be subject to regular routine maintenance in order to ensure the free flow of water to drainage points

Cavity drainage systems are relatively quick to install but may not be suitable for application to convoluted shapes and flat soffits.

Substrates will usually require minimal preparation and drying time, finishes can be applied quickly after installation thus allowing early decoration.

Thermal insulation can be incorporated in a cavity drain system but the potential for interstitial condensation must be considered and additional vapour checks may need to be incorporated.

The forming of channel or rebates into structural or reinforced floor slabs may have unforeseen consequences. It is therefore important to consider the structural implications of this action. If there is any doubt about the ability of a structure to absorb the changing stresses caused by waterproofing, the guidance of a structural engineer should be sought.

8. APPLICATION METHODS

Specifications from manufacturers vary, and it is strongly recommended that applicators liaise closely with a manufacturer to establish exactly how their system should be applied.

There are certain areas however, common to all systems, which need to be highlighted.

CEMENTITIOUS COATINGS AND MULTI-COAT RENDERS

Preparation

Any timbers embedded in the substrate must be removed.

The substrate which is to receive the system must be well keyed to achieve a good sound bond to prevent de-bonding. Any old renders, coatings or general contamination must be removed by suitable means such as grit blasting, high pressure water jetting, scabbling, or other suitable means. Care needs to be taken if wire brushing is used as it can leave the surface soft and dusty. Bush hammering tends to compact the surface and can result in the system pulling away, taking the surface with it.

Soft mortar joints should be raked out, and any unsound and defective areas cut out and made good. Open joints should not be repointed but the mortar should be pushed into the open joints when applying subsequent renders.

Excessive suction should be controlled prior to applying renders by saturating the masonry with water, or applying a suitable bonding agent as a primer or slurry.

Unless the substrate is reasonably flat and true, a render levelling coat should be applied prior to application of the waterproofing system.

Note: Structures built out of soft stone or random materials frequently present a problem. If the soundness of the surface is in doubt, consideration can be given to applying stainless steel lathing, provided the water table is not high, or likely to be high. If water tables are high then an internal structural lining built out of block, designed by a structural engineer, should be considered or risk the structure will not take render.

Curing

After applying the system to the manufacturer's specification, care must be taken to ensure that the renders/coatings do not dry out too quickly. Curing must be carried out strictly in accordance with the manufacturer's specification.

Under no circumstances must the system be force dried in any way.

Care must be taken to ensure that spatter coats do not dry out prior to applying the next coat. These coatings should provide a good mechanical key for the following coat. If allowed to dry out they can become weak and powdery, and act as a release plane for the next coat.

Fixings

Where possible, nothing should be allowed to penetrate the tanking after application, otherwise failure of the system is possible. Where fixings are required, the advice of the manufacturer should be sought prior to applying the system.

Power points, cables, light switches, pipes and any other services must be remounted in front of the waterproofing layer.

Angle beads should not be used within the system itself. If they are incorporated into the finishing coat, they should be of stainless steel or plastic.

Special Problems

Very fine hairline cracking frequently occurs at points of stress concentration occurs, such as wall/floor junctions, retaining wall/partition wall junctions and where differing materials abut, etc.

Where these occur, the manufacturer of the system should have a specification to deal with the problem. The solutions usually involve either fillets to distribute the stress, or flexible membranes.

Bonding agents can be used to cope with situations where there is either insufficient suction for bonding, or so much suction that the hydrating water is removed. When the latter occurs, de-bonding and cracking is almost certain to occur.

Nitrates and sulphates cause deterioration of the waterproofing system over a relatively short period of time. The use of sulphate resisting cement in the renders is recommended, unless special additives are supplied by the manufacturer. Where this is the case, follow the manufacturer's instructions.

IN DEPTH CRYSTALLISATION SLURRIES

These are specifically designed for the waterproofing of concrete structures. They comprise a blend of cement, fine aggregates and active chemicals. The active chemicals react with water and un-hydrated cement in concrete to form insoluble crystalline complexes which block capillaries and pores within the concrete.

Before waterproofing materials are applied it is essential that surface laitance and any surface contamination is removed from the concrete. Concrete should be prepared using high pressure washing or grit blasting to give a clean open textured surface.

Application and curing is to be in accordance with manufacturer's instructions. Apply materials to the surface by either brush or spray.

These materials can also be used as an "anti- lime" coating for cavity drain systems. Refer to manufacturers for guidance on this application.

CAVITY DRAINAGE MEMBRANES

Preparation

Any timbers embedded in the substrate must be removed.

When used in existing buildings, any unsound plaster, render or screed is removed to expose the substrate. Remove any nails or sharp objects and clean with a stiff brush to remove loose material, laitance, salt residue, mould or adhesive.

Uneven substrates should be dubbed out or made good with a suitable render. This should be allowed to harden before the membrane is fixed.

Check and remedy using appropriate methods, any unacceptable leaks in the concrete or masonry substrate before the system is installed.

Prior to installing the cavity drainage membrane on walls constructed of new concrete, the concrete surface should be treated to reduce the risk of leaching of free-lime or mineral salts, this can be done with a proprietary silicic acid compound, crystallization slurry or epoxy coating.

Installation

The membrane should always be used with the flanged edge positioned in front of and overlapping the previously installed membrane width. Joints must be formed in accordance with the manufacturer's instruction.

Fixings are made through the studs into holes drilled through the membrane. Fixing plugs, are inserted into the holes and tapped flush with the membrane. Spacing and sealing of these fixings will depend on the product being applied, the application, the nature of the substrate and the type of finish to be achieved.

Ceilings to be covered should always have a fall (as for vaulted cellar constructions) so water does not lie against the membrane or a joint. Special attention must be given to jointing and providing adequate overlaps in these situations.

The membrane should be adequately fixed, to avoid the possibility of water ponding on top of the membrane. The wall membrane should be cut into the curve of the ceiling, fixed in front of the ceiling membrane, and the gap sealed in accordance with the manufacturers' instructions.

Installation of the membrane is commenced at the top of the construction. The membrane may require initial fixing on the upper edge of a wall, prior to final fixings along batten runs. The lower sheet is always positioned in front of the upper sheet. Detailed instruction on the installation and jointing of wall membranes should be provided by the manufacturer.

The installation is conducted over windows and later the membrane is cut away to expose them, and the gaps sealed. For doors and some obstructions, the membrane is installed up to the perimeter and the gaps are sealed. The membrane is fixed in accordance with the manufacturers' instructions, using the appropriate fixing and sealing materials.

Power points, cables, light switches, pipes and any other services must be remounted in front of the membrane.

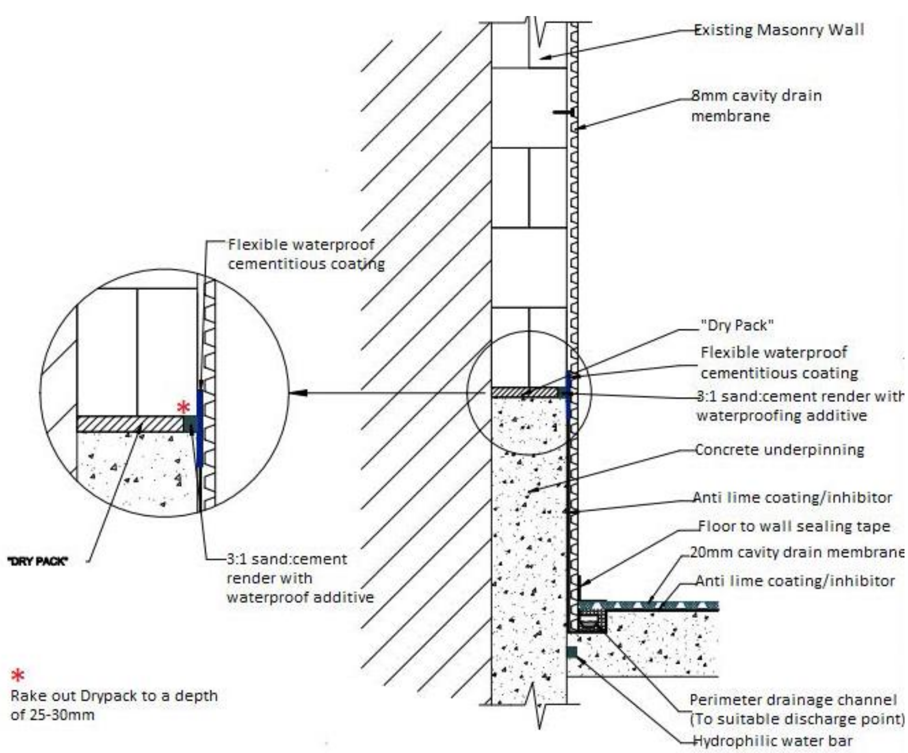
A flood test should be undertaken to check floor levels and to ensure that the drainage system works effectively.

9. UNDER PINNING WITHIN EXISITING UNDERGROUND STRUCTURES

Where new structural elements have been added such as new floor slabs or underpinning, then special consideration must be given on the best methods of waterproofing these new elements.

Free lime and mineral salts can leach from dry pack and new concrete and pose the potential risk of failure to Type C systems. As free lime leaches from the new construction by groundwater ingress, it deposits itself within the drainage cavity, (behind and underneath membranes) and particularly within the sump chamber and around the sump pumps. Thus, blocking free drainage,

Typical waterproof detailing of underpinning



potentially causing pump failure and therefore failure of the system.

In order to minimise the risk of free lime impacting on the system, an “anti-lime” coating should be applied to the new concrete especially for retrofit basements or where underpinning is being used. Where dry pack has been used then special detailing will be required. This should reduce the amount of free lime leaching into the system but also improve the water resistance of the basement structure, improving the overall reliability of the installation.

Where any new structural elements have been added then the frequency of maintenance should be increased especially in the initial period after installation.

Attention must be paid to the detailing at the top of the underpinning as the various substrates may cause cracking of some Type A “barrier” waterproofing systems.

10. PROBLEM SOLVING

The following is a summary of some common faults and their solutions.

Use of Electronic Moisture Meters

Moisture meters in a basement situation should be used with great caution. Due to environmental conditions, a small degree of dampness will usually be present in basements and show on a moisture meter. The meter should be used for comparative readings, and then only by an experienced person.

Where hygroscopic salts are suspected, the wall should first be checked. If salts are present, do not use a moisture meter but investigate the cause of the salt that is present.

Under no circumstances should a wall be tested for moisture in depth. Results will be meaningless as there will usually be significant dampness immediately behind a tanking system. The waterproofing system may also be damaged in the process.

ASSESSING THE CAUSE

Dampness on the surface of a waterproofing system will invariably be a result of one of the following:

Internal Plumbing Leak

When internal plumbing defects occur, they can manifest themselves in many ways depending on the location and severity of the leak. It is important that the surveyor investigating dampness in the building is aware of the location of water and central heating pipes before investigations begin.

When plumbing leaks are detected these should be repaired and the extent of the water damage must be properly quantified. Any making good to the wall and floor finishes should be undertaken by the waterproofing contractor to ensure that this does not compromise the waterproofing system.

Condensation

If the surface is damp, but immediately behind the surface it is dry, then the dampness is almost certainly surface condensation.

The use of a diagnostic hygrometer and surface thermometer can be used to check if condensation is occurring at the time of the inspection. If not, a condensation data logger can be left on the surface. It can be electronically interrogated at a later stage to see if condensation has occurred.

If there is still doubt, a check for salts will help. The presence of chlorides and/or nitrates would probably indicate that there is lateral penetration of ground water. (Beware, however of contamination from other sources, such as salt from water softeners, salts that are introduced in building materials or nitrates from damaged drains etc.).

Surface condensation can usually be cured by adequate air control such as increasing ventilation, dehumidifiers or a central air conditioning system. Increasing the internal temperature without improving ventilation can make matters worse.

Further details on the control of condensation can be found at www.property-care.org

Permeability of the System

If the waterproofing system has had renders and plasters applied over it, it will be necessary to remove these layers prior to assessing where water is permeating through the system.

If condensation is ruled out and the damp patches seem to follow an ill-defined pattern, then it is likely that there is some water penetration through the system itself.

General water penetration and breaks in the system will need to be dealt with in accordance with the manufacturers recommendations.

A break in the waterproofing system

If the waterproofing system has had renders and plasters applied over it, it will be necessary to remove these layers prior to assessing where there is a break in the system.

If the dampness emanates from a distinct point, or points, then a pinprick hole is likely. If it seems to be over a large area, but follows a line, then cracking or failure of a joint is likely.

Failure of Drains and Pumps

Blockage of cavities and drains, or a failure of pumps can result in uncontrolled water build are within a cavity drainage system. Water or dampness will come through as joints and seams not designed to withstand hydrostatic pressure. It is essential that some form of access for water jetting and/or maintenance is planned and built into the system.

Cracking and de-bonding of Renders

Where renders crack and de-bond, it will be necessary to remove a section of the render to examine the substrate/render interface and, if necessary, to send the render for analysis for contaminating salts.

Usually, when de-bonding render is removed the cause of the de-bond is obvious from a visual inspection, e.g. dust or paint on the substrate, or incorrectly gauged render mixes.

All cementitious systems are prone to shrinkage, so cracking and de-bonding is something that will invariably occur to some degree.

It is difficult to be specific about when remedial work becomes necessary, although consideration should be given to removing and re-applying affected areas in the following circumstances: -

1. When moisture penetrates the crack.
2. If the cracks are excessively unsightly.
3. If the render starts coming away from the substrate.

Tests for Conformity

It is not normally considered necessary to test pre-mixed materials for conformity to manufacturer's specifications while they are being built in, as any testing necessary is usually done before arriving on-site. However, there may be occasions where the testing is considered necessary for a precautionary reason, or if there is a failure of the system during the construction phase.

Where mixes are made up on site, or where a material is used as an additive for a specified mix, conformity tests might be required by the client as routine, or if there are failures.

Mixes Batched on Site

If the mix is a render, the conformity that would normally be required would be testing that the aggregate: cement and water: cement ratios are correct, and that the correct sands have been used. There are several independent testing laboratories who undertake this work.

If there are special additives used in the mix, the testing can be done either by the manufacturer (if they offer this service) or by an independent laboratory, with the manufacturer's co-operation.

Tests for Contamination

Where it is thought that problems are caused by contaminating salts, either mixed into the materials or which have accumulated over a period of time, then an independent laboratory will provide the necessary testing facilities.

Simple salt analysis kits for on-site testing of the common salts such as chlorides and nitrates are available, and can be very beneficial. However, they will not provide information on sulphates, acids, oils, etc. This information will need fairly specialised equipment, and is usually only found in an analytical laboratory.

11. OTHER SOURCES OF INFORMATION

This Code of Practice should be read in conjunction with;

British Standards

From: BSI Publications, Linford Wood, Milton Keynes MK14 6LE

- BS 8102:2009 - Code of Practice for protection of below ground structures against water from the ground
- BS 8485:2015 - Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings

BRE

From: BRE Bookshop, BRE, Garston, Watford WD2 7JR

- Digest 297 – Surface Condensation and Mould Growth.
- Good Building Guide, GBG 72-1 BRE 2007 – Basement construction and waterproofing

Property Care Association (Downloadable from www.property-care.org)

- Best Practice Guidance - Type A Waterproofing Systems
- Best Practice Guidance - Type B Waterproofing Systems
- Best Practice Guidance - Type C Waterproofing Systems
- Guidance for the Service and Maintenance of Drained Cavity Waterproofing systems (Type C)

The information contained in this leaflet is given in good faith and is believed to be correct. However, it must be stressed that of necessity it is of a general nature. The precise condition may alter in each individual case and the Association is therefore unable to accept responsibility for any loss howsoever arising from the use of the information contained therein.

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SWG-COP-WEBGS-V1-0817